The present invention relates to a support device for a rotary drum such as, for example, an oven, drier, cooler, or other apparatus, intended, in particular, for heat and/or chemical treatments for materials. It also relates to a rotary drum equipped with such a support device.

Although more especially developed for the applications mentioned above, the present invention can also be used in numerous other sectors of industrial activity, such as, for example, the farm-produce industry, to equip, in particular, primary sugar extractors or the like.

The rotary drums currently used in these different fields are habitually of a substantially cylindrical, elongated shape. For support, they rest on cylindrical rollers, generally disposed in pairs to constitute a rolling station directly co-operating with the outer shell of the drum or with roller rings and/or tracks, or strips, provided around the said outer shell.

The axes of the rollers are parallel to the main axis of the drum. The rolling stations, hence the rings, are at least two in number : in this case, the drum is isostatically supported. They can also be more numerous, according to the dimensions of the apparatus, and, in particular, the length/diameter ratio. There may thus be three, four or more rolling stations. In this case, the support is 'hyperstatic', or statically redundant.

By way of example, the calcining kilns or furnaces used in the cement industry or in the treatment of ores have diameters possibly in excess of 7 m and lengths possibly in excess of 200 m ; primary sugar extractors can have a diameter of 9 m or more for a length of 60 m or more.

The rotational movement of the apparatus is most often obtained by means of an annular gear fixed to the outer wall, driven by one or more gear wheels, themselves driven by a motor.

Another known technique, particularly in the sugar industry, consists in driving the apparatus directly through friction between roller and roller ring, one or more rollers being driven via a mechanical or hydraulic transmission system.

The rotary drum is subjected to numerous mechanical stresses, either on account of its movement, and of the weight of the material being processed, or on account of temperature gradients when heat exchange takes place. It is liable, therefore, to become deformed, temporarily or permanently, with the result that its main axis is no longer rectilinear.

One consequence is that the part of its axis located in the area of contact between roller and roller ring is not parallel to the axis of the rollers.

In this case, contact between the rollers and the roller ring is not uniform over the entire width. The stress applied to the roller, and to the roller ring, can then attain locally high values which cause abnormal, irregular wear.

In addition, when the drum is driven in rotation by the roller or rollers, the contact surface may become insufficient to transmit the driving torque.

To avoid this drawback, there are known roller supports enabling the axis of the roller to be held constantly parallel to that of the roller ring. However, in the devices developed to date to obtain this result, the mobility of the roller support is obtained by means of sliding connections.

Such devices thus require maintenance so that sliding can always take place. In addition, the said sliding causes wearing of the mechanical components in question, and generates a load moment which opposes the mobility of the support and causes a phenomenon of hysteresis.

The object of the present invention is to provide a support device for a rotary drum, including at least one roller capable of co-operating with the said drum, such as to remedy the aforementioned drawbacks and enable the axis of the roller to be held constantly parallel to that of the drum.

Another object of the invention is to provide a support device for a rotary drum in which the number of parts subjected to friction is minimised.

One advantage of the present invention is that it slows down the wearing of the mechanical parts used.

Further objects and advantages of the present invention will emerge in the course of the description that follows, which is given merely by way of illustration and is not intended to limit same.

The present invention relates to a support device for a rotary drum such as, for example, an oven, drier, cooler or other apparatus, intended, in particular, for heat and/or chemical treatments for materials, including at least one roller, capable of co-operating with the said drum, and at least two bearings, capable of permitting the rotation of the said roller about is axis of rotation, characterised by the fact that it further includes :

- a chassis, to which the said bearings are secured, mounted for pivoting about a pivotal axis substantially perpendicular to the plane passing through the axis of rotation of the said roller and normal to the base, or block, on which the said device is placed , termed a 'pivotal plane ' ;

- connecting means, flexible in a given direction, termed the 'direction of flexibility', and rigid in the directions orthogonal to the said direction of flexibility, to maintain the said bearings on the said block while permitting free pivotal movement of the said chassis, in such a way as to permit alignment of the said roller on the drum in the event of the latter pivoting.

The invention also relates to a rotary drum equipped with at least one support device as described above.

The present invention will be more readily understood from a study of the following description, accompanied by the annexed drawings, which form an integral part thereof, and wherein :

- figure 1 is a cross-sectional view illustrating a first exemplary form of embodiment of the support device according to the invention, the cross-section being effected in a plane perpendicular to the axis of rotation of the rotary drum with which the said support device co-operates ;

- figure 2 is a cross-sectional view along line II-II of preceding figure 1 ;

- figure 3 is a cross-sectional view, produced in the same way as in figure 2, illustrating another advantageous exemplary embodiment of the support device according to the invention ;

- figure 4 again shows the support device illustrated in figure 1 in a different utilisation configuration.

The present invention relates to a support device for a rotary drum such as, for example, an oven, drier, cooler or other apparatus, intended, in particular, for heat and/or chemical treatments for materials.

However, although more especially designed for such applications, it can also be used in numerous other sectors of industrial activity, such as, for example, the farm-produce industry, to equip, in particular, primary sugar extractors or other apparatus.

Generally speaking, the said rotary drums are constituted, for example, by apparatus which are substantially cylindrical, having a tubular structure which is substantially circular in cross-section, capable of being driven about their longitudinal axes.

As shown in figure 1, the support device 1 for a rotary drum 2 according to the invention includes at least one roller 3, capable of co-operating with the said drum 2.

The said roller 3 permits, in particular, either the rolling only of the said drum 2, the latter being driven by other means, or both the rolling and the driving of the said drum. It has, for example, a cylindrical structure, with a circular cross-section, its axis of rotation 4 being substantially parallel to that of the said drum 2.

To permit rotation of the said roller 3 about the said axis of rotation 4, the support device 1 according to the invention also includes at least two bearings 5, 5'.

In the remainder of the text, to make it easier to understand how the device according to the invention operates, we shall use a system of orthogonal co-ordinates, x, y, z, with the y direction corresponding to that of the axis of drum 2 and/or of roller 4, and the z direction corresponding to that of the line perpendicular to the block 6 on which the said device 1 is placed.

According to the invention, the said support device 1 enables the said roller 3 to be aligned on drum 2 in the event of the latter pivoting.

For this purpose, as can be seen, when referring to both figures 1 and 2, it further includes a chassis 7, to which are secured bearings 5, 5'. As illustrated by double arrow 12, the said chassis 7 is mounted so as to be able to pivot about a pivotal axis, orientated in the direction x and bearing reference number 11, substantially perpendicular to the plane y, z passing through the axis of rotation 4 of the said roller 3 and perpendicular to the block 6, called the 'pivotal plane '.

Thus, when the position of the axis of drum 2 varies in the course of its operation, roller 3 is capable of making its axis 4 parallel with that of the said drum 2, and of ensuring uniform contact with the peripheral surface of the said drum 2.

In addition, to hold the said bearings 5, 5' on the said block 6, while permitting free pivotal movement of the said chassis 7, the said support device 1 includes connecting means 8, flexible in a given direction, referenced 9, 9', called the 'direction of flexibility', and rigid in the directions orthogonal to the said direction of flexibility 9, 9'.

The movements as a whole are thus effected without sliding, which thus makes it possible to reduce wear phenomena.

The length of chassis 7 is, for example, slightly greater than the centre to centre distance of axes provided for between the said bearings 5, 5'.

The said connecting means 8 are constituted, for example, by at least two elongated pieces 10, 10', in particular parallelepiped, provided so as to be substantially symmetrically on either side of plane x, z, called the 'mid-plane', passing through pivotal axis 11 and orthogonal to the said pivotal plane y, z. The said pieces 10, 10' are secured, on one hand, to the said chassis 7 and, on the other hand, to the said block 6, in particular via a supporting member 13.

The said direction of flexibility 9, 9' is designed, for example, to have an orientation approximating to the line z perpendicular to block 6 or merging with the said line perpendicular to block 6.

The said elongated pieces 10, 10' are constituted, in particular, by a beam with a cross-section that is flattened, for example substantially rectangular, and the thickness of which is small in relation to the width and the length of the said beams, the length of the said flattened cross-section being orientated in a direction substantially orthogonal to the said direction of flexibility 9, 9'.

It will also be noted that, when chassis 7 pivots, through the action of drum 2, the said elongated pieces 10, 10' are subject to deformation, in particular in flexion, for example being elastically deformed as a function of the nature of the material chosen.

In practice, this deformation is very slight. The amplitude of drum 2 deformation is, in fact, quite small. In addition, under normal operating conditions, the amplitude of the vertical movements of the said chassis 7 must not exceed a given value, which can be fixed, by way of example, at 8.10^{-5} times the length of drum 2.

In this connection, device 1 according to the invention can further include adjusting blocks 14, 14' and/or stops 15, 15', capable of limiting any displacement of the said device 1.

The said adjusting blocks 14, 14' are, for example, fixed to block 6 and mechanically restrict the amplitude of the vertical movement of chassis 7 to a value less than or equal to an upper limit situated between 3.10^{-5} and 8.10^{-5} times the length of the drum 2. They thus prevent the support device 1 from being damaged following the occurrence of abnormal conditions.

For similar reasons, stops 15, 15' are, for example, fixed to block 6 on each side of the longitudinal ends of the said chassis 7. They thus prevent horizontal movement of the latter in direction y.

The said elongated pieces 10, 10' are, for example, perpendicular to the said chassis 7 and thus orientated substantially parallel to direction y.

As shown in figure 3, according to one advantageous form of embodiment, the said direction of flexibility 9, 9' is designed to have an orientation approximating to the tangent to the circle having as its centre the

point of intersection between the plane of articulation y, z and pivotal axis 11 and passing in the area of the point at which the said elongated pieces 10, 10' are attached to chassis 7. In this particular case, the said beams 10, 10' are, for example, orientated radially.

The said pivotal axis 11 is provided, in particular, in the area of the plane of symmetry x, z of the bearings 5, 5', that is to say in the area of the mid-plane.

According to a first alternative form of embodiment, pivoting is effected by rotation about the said pivotal axis 11.

However, according to one advantageous alternative form of embodiment, corresponding to the one illustrated in figure 3, pivoting can be effected by rolling. For this purpose, device 1 further includes, for example, a support member 16, in the area of which the said pivotal axis 11 is provided.

The said support member 16 is constituted, in particular, by two pieces, 17, 17', co-operating with one another, the upper one 17' being secured to the said chassis 7, and the other, lower one, 17, to the said block 6. The said pieces 17, 17' are formed by a sector of a cylinder with a circular cross-section, the axis of the said cylinder being parallel to the pivotal axis 11 and the radius of the upper piece 17' being, for example, slightly smaller than the radius of lower piece 17.

According to another form of embodiment, one of the said pieces 17, 17' can have a plane contact surface.

In these different cases, chassis 7 then rolls, without sliding, on block 6, the pivotal axis 11 being defined by the line of contact between the said lower and upper pieces 17, 17'.

This being the case, figure 4 represents, by the direction referenced 18, the resultant of the forces exerted on roller 3 by the weight of the drum 2, on one hand, and the frictional forces, on the other hand.

In order for support device 1 as a whole to be in stable mechanical equilibrium, the said resultant 18 must intersect support member 16 between its two end points. It may be necessary, in order to fulfil this condition, to

increase the dimensions of device 1 beyond what is necessary for its mechanical strength.

To avoid this, it is also possible, if applicable, to provide a device 1 inclined by a given angle α in relation to the horizontal in the direction of drum 2 in a plane perpendicular to the pivotal plane y, z in such a way that the said resultant 18 of the forces exerted by drum 2 on the said device 1 passes in the vicinity of the intersection of the said pivotal plane y, z and of the pivotal axis 11.

In this case, the said block 6 is itself also, possibly, inclined by the same angle α.

The invention also relates to a rotary drum 2 equipped with at least one support device 1 as presented hereabove.

Advantageously, the said rotary drum 2 will be equipped with one or more rolling stations constituted by two said support devices 1 as described hereabove.

Incidentally, it should be noted that roller 3 is either in direct contact with the outer surface of the said drum 2, or in contact with a ring provided around the said drum 2 in the area of each rolling station, as shown.

Furthermore, as already mentioned, the invention can be applied to rotary drums of a large size, whatever the way in which they are driven, either via an annular gear and gear wheels, or by friction between roller and drum. In the latter case, the drive rollers will advantageously be integrated in support devices 1 such as those described above.

Other forms of embodiment, within the grasp of a man of the art, could, of course, have been contemplated without thereby departing from the scope of the present application.